

Amendments to the Claims:

This listing of claims will replace all prior versions and listings of claims in the application:

Listing of Claims:

1. (Previously Presented) A method for estimating a propagation channel in a presence of transmit beamforming with a receiver, comprising the steps of:
accounting for a structure of two logical channels (CPICH, DPCH) and based on a common structure of corresponding propagation channels, one (DPCH) of said two logical channels comprising two sub-channels (DPDCH, DPCCH);
providing channel estimation in a multipath environment to acquire a beamforming complex factor,
wherein the providing step comprises modeling said propagation channels in the receiver as a linear superposition of a finite number of discrete multipath components ($p=1, \dots, P$) following an uncorrelated-scattering wide-sense stationary model, and
wherein a multipath component is characterized by a time-varying multipath complex coefficient ($c_p(t)$ and $(\beta_p c_p(t))$ and a delay (τ_p).

2. (Previously Presented) The method of claim 1, wherein said propagation channel corresponds to the first sub-channel (DPDCH), and
wherein the providing step further comprises providing estimates of each multipath component ($p=1, \dots, P$) complex coefficient ($\beta_p c_p(t)$) according to a maximum-a-posteriori (MAP) optimization criterion accounting for the whole available information associated with said logical (CPICH, DPCH) and corresponding propagation channels, comprising the steps of:

building a second channel comprising (DPCH) and a first channel comprising (CPICH) having instantaneous maximum likelihood (ML) channel multipath complex coefficients estimates ($\hat{c}_{dpch}(n)$, and $\hat{c}_{pich}(n)$);

performing interpolation of the above obtained ML instantaneous second (DPCH) and first (CPICH) channel multipath complex coefficient estimates ($\hat{c}_{dpch}(n)$, and $\hat{c}_{pich}(n)$) to a lowest symbol rate of said second (DPCH) and first (CPICH) logical channels;

computing an optimal linear prediction filter (f) according to a joint second and first channels (DPCH-CPICH) maximum-a-posteriori (MAP) criterion;

filtering the interpolated ML instantaneous second (DPCH) and first (CPICH) channel multipath complex coefficient estimates obtained at step 2 with said optimal linear prediction filter in order to obtain a MAP first sub-channel (DPDCH) multipath coefficient estimate ($\tilde{c}_{dpch-MAP}(k)$); and

interpolating said MAP first sub-channel (DPDCH) multipath coefficient estimate ($\tilde{c}_{dpch-MAP}(k)$) to the second logical channel (DPCH) symbol rate when said symbol rate is lower than the first logical channel (CPICH) symbol rate.

3. (Previously Presented) A method for estimating a propagation channel in a presence of transmit beamforming characterized in that said propagation channel corresponds to a first sub-channel (DPDCH) and that said method provides estimates of each multipath component ($p=1, \dots, P$) complex coefficient, accounting for the whole available information associated with two logical channels (CPICH, DPCH) and corresponding propagation channels with a receiver, comprising the steps of:

building a second channel comprising (DPCH) and a first channel comprising (CPICH) having instantaneous maximum likelihood (ML) channel multipath coefficients estimates ($\hat{c}_{dpch}(n)$ and ($\hat{c}_{pich}(n)$);

performing interpolation of said ML instantaneous first (DPCH) and second (CPICH) channel multipath coefficient estimates ($\hat{c}_{dpch}(n)$ and $\hat{c}_{cpich}(n)$) to the lowest symbol rate of said second (DPCH) and first (CPICH) logical channels;

building an optimal maximum a posteriori estimate ($\tilde{c}_{cpich-MAP}(k)$) of the first (CPICH) channel multipath coefficient ($\tilde{c}_{cpich}(k)$);

building an estimate of a cross-correlation ($\hat{\phi}_{dc}(l)$) between the first (CPICH) and second (DPCH) channel multipath coefficient instantaneous maximum likelihood estimates obtained at step 2 (\hat{c}_{dpch} and \hat{c}_{plch}) and an estimate of an autocorrelation ($\hat{\phi}_{dc}(l)$) between the (CPICH) channel multipath coefficient instantaneous maximum likelihood estimates (\hat{c}_{plch}) of step 1 and 2 at non-zero correlation lag ($l \neq 0$) for noise suppression;

building an estimate ($\hat{\beta}$) of a beamforming complex factor (β) of said correlation and autocorrelation estimates;

building a first sub-channel (DPDCH) multipath coefficient estimate ($\tilde{c}_{cpich}(k)$) as a product of the estimates obtained at building an optimal step ($\tilde{c}_{cpich-MAP}(k)$) and building an estimate step ($\hat{\beta}$), and

interpolating said first sub-channel (DPDCH) multipath coefficient estimate ($\hat{c}_{cpich}(k)$) to the second logical channel (DPCH) symbol rate when said symbol rate is lower than the first logical channel (CPICH) symbol rate.

4. (Previously Presented) The method of claims 2 or 3, wherein the first logical channel (CPICH) maximum likelihood channel multipath coefficient estimates ($\hat{c}_{plch}(n)$) are computed based on the a-priori knowledge of some pilot symbols forming said first logical channel (CPICH).

5. (Previously Presented) The method of claims 2 or 3, wherein the second logical channel (DPCH) maximum likelihood channel multipath coefficient estimates ($\hat{c}_{dpch}(n)$), related to the second sub-channel (DPCCH), are computed based on the a-priori knowledge of the pilot symbols forming said second sub-channel (DPCCH).

6. (Previously Presented) The method of claims 2 or 3, wherein the second logical channel (DPCH) maximum likelihood channel multipath coefficient estimates ($\hat{c}_{dpch}(n)$) related to the first sub-channel (DPDCH) are computed by a decision-direct mechanism.

7. (Previously Presented) The method of claims 2 or 3, wherein the interpolation of step is performed by nearest neighbor interpolation.

8. (Previously Presented) The method of claim 2, wherein the optimal linear prediction filter is built according to the maximum-a-posteriori optimization criterion, based on the interpolated maximum likelihood channel multipath coefficients estimates ($\hat{c}_{dpch}(n)$ and ($\hat{c}_{pich}(n)$) related to said first (CPICH) and second (DPCH) logical channels in order to provide an optimal by joint second and first channel (DPCH-CPICH) maximum-a- posteriori first sub-channel (DPDCH) multipath coefficient estimate ($\tilde{c}_{dpch-MAP}(k)$).

9. (Previously Presented) The method of claim 3, wherein a maximum likelihood estimate of the second (DPCH) corresponding propagation channel and first (CPICH) corresponding propagation channel cross-correlation ($E\{\hat{c}_{dpch}(n)\hat{c}_{pich}^*(n-l)\}$) and a maximum likelihood estimate of the first (CPICH) corresponding propagation channel autocorrelation ($E\{\hat{c}_{dpch}(n)$ and $\hat{c}_{pich}^*(n-l)\}$) are computed based

on the sample moments ($\hat{\phi}_{dc}(l)$) and ($\hat{\phi}_{cc}(l)$) of the first (CPICH) and second (DPCH) channel maximum likelihood estimates ($\hat{c}_{dpch}(n)$, and $\hat{c}_{pich}(n)$).

10. (Previously Presented) The method of claim 3, for the computation of the estimate of said complex beamforming factor (β) characterized in that the second logical channel (DPCH) and the first logical channel (CPICH) corresponding propagation channel cross-correlation and the first logical channel (CPICH) corresponding propagation channel autocorrelation maximum likelihood estimates ($\hat{\phi}_{dc}(l)$) and ($\hat{\phi}_{cc}(l)$) at different correlation lags ($l = 1, 2, \dots, L$) are linearly combined ($\sum_{l=1}^L a_l \hat{\phi}_{dc}(l)$ and $\sum_{l=1}^L a_l \hat{\phi}_{cc}(l)$).

11. (Previously Presented) The method of claim 3, wherein the second logical channel (DPCH) and first logical channel (CPICH) cross-correlation and the first logical channel (CPICH) autocorrelation successive estimates ($\hat{\phi}_{dc}(l)$) and ($\hat{\phi}_{cc}(l)$) are taken at a fixed lag (l) and are low-pass filtered for the computation of the estimate of said complex factor (β).

12. (Previously Presented) The method of claim 3, wherein the estimate of said complex factor (β) is built as a linear combination of the beamforming complex factor estimates computed as the ratio of the second logical channel (DPCH) and the first logical channel (CPICH) corresponding propagation channels cross-correlation and the first logical channel (CPICH) corresponding propagation channel autocorrelation estimates at a certain lag (l) ($\hat{\beta}_{ML}(l) = \hat{\phi}_{dc}(l) / \hat{\phi}_{cc}(l)$), ($\hat{\beta} = \sum_{l=1}^K \gamma_l \hat{\beta}_{ML}(l)$) at lag $l = 1, 2, \dots, K$.

13. (Previously Presented) The method as claimed in any one of claims 10, 11 or 12, wherein the estimate of said complex factor (β) is limited to the lag equal to 1.

14. (Previously Presented) A receiver utilizing said methods as claimed in any one of claims 1, 2, and 3.

15. (Previously Presented) An apparatus for estimating a propagation channel in a presence of transmit beamforming by accounting for a structure of two logical channels referred to as a common channel and a dedicated physical channel (CPICH, DPCH), and based on a common structure of corresponding propagation channels, said dedicated physical channel (DPCH) comprising two sub-channels (DPDCH, DPCCH), comprising:

a receiver providing channel estimation in a multipath environment to acquire a beamforming complex factor by modeling said propagation channels as a linear superposition of a finite number ($p=1, \dots, P$) of discrete multipath components following an uncorrelated-scattering wide-sense stationary model, and wherein a multipath component is characterized by a time-varying multipath complex coefficient ($c_p(t)$ and $\beta_p c_p(t)$) and a delay (τ_p).

16. (Previously Presented) The apparatus of claim 15, wherein said apparatus further comprises:

means for building a second logical channel comprising a (DPCH) channel and a first logical channel comprising a (CPICH) channel for corresponding propagation channel instantaneous maximum likelihood ML channel multipath coefficient estimates ($\hat{c}_{dpch}(n)$ and $\hat{c}_{cpich}(n)$);

means for performing interpolation of the above obtained (ML) instantaneous second (DPCH) and first (CPICH) logical channel corresponding propagation channel multipath coefficient estimates ($\hat{c}_{dpch}(n)$) and ($\hat{c}_{cpich}(n)$) to a lowest symbol rate of said second (DPCH) and first (CPICH) logical channels;

means for building an optimal linear prediction filter according to a joint second and first (DPCH-CPICH) channel maximum-a-posteriori criterion;

means for building a first sub-channel (DPDCH) multipath coefficient estimate ($\tilde{c}_{dpch-MAP}(k)$) by filtering with said optimal linear prediction filter with said interpolated ML instantaneous second (DPCH) and first (CPICH) logical channel corresponding propagation channel multipath coefficient estimates ($\hat{c}_{dpch}(n)$) and ($\hat{c}_{cpich}(n)$); and

means for interpolating said first sub-channel (DPDCH) multipath coefficient estimate ($\tilde{c}_{dpch-MAP}(k)$) to the second logical channel (DPCH) symbol rate when said symbol rate is lower than the first logical channel (CPICH) symbol rate.

17. (Previously Presented) The apparatus of claim 15, further comprising:

means for building a second logical channel comprising a (DPCH) channel and a first logical channel comprising a (CPICH) logical channel for corresponding propagation channel instantaneous maximum likelihood ML channel multipath coefficient estimates ($\hat{c}_{dpch}(n)$) and ($\hat{c}_{cpich}(n)$),

means for performing interpolation of the above obtained ML instantaneous second (DPCH) and first (CPICH) logical channel corresponding propagation channel multipath coefficient estimates ($\hat{c}_{dpch}(n)$) and ($\hat{c}_{cpich}(n)$) to a lowest symbol rate of said second (DPCH) and first (CPICH) logical channels,

means for building an optimal maximum a posteriori estimate ($\tilde{c}_{cpich-MAP}(k)$) of the first logical channel (CPICH) multipath coefficient ($c_{cpich}(k)$),

means for building an estimate ($\hat{\phi}_{dc}(l)$) of a cross-correlation ($E\{\hat{c}_{dpch}^*(n)\hat{c}_{dpch}(n-l)\}$) between the first (CPICH) and second (DPCH) logical channel corresponding propagation channel multipath coefficient instantaneous maximum likelihood estimates ($\hat{c}_{dpch}(n)$ and ($\hat{c}_{cpich}(n-l)$) and an estimate ($\hat{\phi}_{dc}(l)$) of an autocorrelation ($E\{\hat{c}_{dpch}(n)\hat{c}_{dpch}^*(n-l)\}$) between the first logical channel (CPICH) corresponding propagation channel multipath coefficient instantaneous maximum likelihood estimates ($\hat{c}_{dpch}(n)$) at non-zero correlation lag ($l \neq 0$) for noise suppression, means for estimating a beamforming complex factor (β) from said cross-correlation and the auto correlation estimates ($(\hat{\phi}_{dc}(l))$ and ($\hat{\phi}_{cc}(l)$),

means for building a first sub-channel (DPDCH) multipath coefficient estimate ($\tilde{c}_{cpich}(k)$) as a product of the optimal maximum a posteriori estimate ($\tilde{c}_{cpich-MAP}(k)$) of the first channel (CPICH) multipath coefficient and the cross-correlation and the auto correlation estimates ($(\hat{\phi}_{dc}(l))$ and ($\hat{\phi}_{cc}(l)$), and

means for interpolating said first sub-channel (DPDCH) multipath coefficient estimate ($\tilde{c}_{cpich-MAP}(k)$) to the second logical channel (DPCH) symbol rate when said symbol rate is lower than the first logical channel (CPICH) symbol rate.

18. (Canceled)

19. (Previously Presented) A communication system using the method for estimating a propagation channel in the presence of transmit beamforming as claimed in claim 1, when information data are transmitted through a beamforming system.